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Harry Clark Woodworth — 1885-1953

Report of the Director

OF THE

New Hampshire Agricultural Experiment Station

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, NEW HAMPSHIRE

Foreword

This publication is the 65th annual report of the Director of the Agricultural Experiment Station at the University of New Hampshire. The reporting period is from July 1, 1952, to June 30, 1953. The individual summaries of projects were prepared by the respective project leaders. The material is organized by departments and not necessarily by subject matter in all instances.

As projects are terminated and new ones introduced, a trend toward more emphasis on basic research becomes apparent. Conceivably, the pendulum may swing too far in this direction, but for the time being it would appear that there is need for reexamining basic principles with the purpose of discovering new fundamental laws upon which to build a research program of an applied character. Surely there is much to learn in such areas as inbred lines, plant nutrition, mineral nutrition, agricultural engineering, and conservation.

Plans to supplement the director's annual report with a quarterly report in a more popular form for general distribution will be deferred awaiting more adequate funds and personnel.

Harold C. Grinnell
Director

Mathias C. Richards
Associate Director

COVER: Harry Clark Woodworth—September 9, 1885, to September 18, 1953. As Professor of Agricultural Economics he served the University and the State efficiently and effectively from 1921 to the date of his death, fulfilling his manifold tasks with distinction and singular wisdom, rising to a position of eminence among agricultural economists.

REPORT OF THE DIRECTOR

OF THE

New Hampshire Agricultural Experiment Station

July 1, 1952, to June 30, 1953

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, NEW HAMPSHIRE

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Agricultural and Biological Chemistry

Effect of Excess Amino Acids on Growth of Certain Lactobacilli

The effect on growth of lactic acid bacteria from individual excesses of 15 amino acids was studied. The organisms employed were *L. arabinosus, L. fermenti, L. casei,* and *L. leichmannii.* Growth repression of some of the organisms was caused by an excess of aspartic acid, glutamic acid, arginine, valine, methionine, serine, or histidine. None of these compounds repressed the growth of all organisms tested. It is concluded that the growth repressions were due to toxicity of the individual amino acids concerned and not to amino acid imbalance.

A. E. Teeri

Soluble Substances in Grass and Legume Silage

Studies so far have shown little difference in the nature of these simple nitrogen compounds present in forages and in the silages made from them. The total amounts of these nitrogen compounds in silage is far greater than in the fresh forage.

T. G. Phillips

Studies Concerning the Determination of Ascorbic Acid in Food

The tomato fruit is a good source of vitamin C. Plant breeders have spent much time and effort in further improving the nutritive value of the tomato. Dr. A. F. Yeager of the University of New Hampshire's Horticultural Department has produced a new tomato variety known as Doublerich which has considerably more vitamin C than the standard varieties.

Previous studies in this laboratory have shown the presence of an enzyme system capable of destroying vitamin C in chopped, sliced, or macerated tomatoes. If the tomatoes are heated, the enzyme is inactivated and no longer able to destroy the vitamin C.

In 21 samples tested, the anti-vitamin enzyme was found in large amounts as follows: in one of the plant introduction varieties used for breeding, two varieties with immature fruits, and in one hybrid with mature fruits. The tests indicate that the anti-vitamin enzyme is carried along to the progency in certain crosses more than others.

S. R. Shimer

Lasting Effect of Minor Elements and the Effect of Sulfur and Lime Applications on the Yield of Oats

Lime had a depressing effect on the uptake of added cobalt and manganese in both clover and grasses. Applications of cobalt effectively increased the content of the forage; applications of zinc gave slight increases; manganese, copper, and iron showed little effect. The clovers contained a higher mineral content than the grasses, and the leafy portions of the clovers contained the most.

Greenhouse work with oats, using Paxton, Melrose, Charlton, and Buxton soils, showed that the 600-pound application of sulfur gave yields

similar to those of the checks, while both the two- and the six-ton applications of lime decreased the yields. The Paxton soil had the greatest percent decrease while the Melrose showed the least effect from any of the treatments.

G. P. Percival

Preservation of Carotene in Silage by the Use of Sodium Bisulfite As a Preservative

The effect of sodium bisulfite in the preservation of the carotene content of timothy, red clover, and alfalfa, where used as silage, was investigated. Timothy showed very little loss from the treated sample and 20 percent loss from the untreated sample. Alfalfa had four percent loss on the treated sample and ten percent loss on the untreated. Red clover was a poor third with a 27 percent loss on the treated sample and 50 percent loss on the untreated. Further samples of timothy, red clover, ladino, and brome grass are still in the silo for later analysis.

G. P. Percival

OTHER ACTIVE PROJECTS

A Statewide Survey of the Nutritive Value of Home-canned Fruits and Vegetables in New Hampshire

S. R. Shimer

The Carbohydrates of Pasture Grasses

T. G. Phillips

Agricultural Economics

Marketing Mixed Grain Feed

Observations have been made concerning two phases of mixed feed handling: 1. the problems involved in delivering grain from store or freight car to the farmer's feed room, and 2. the storage, handling, and feeding of mixed grain at the farm.

The delivery of grain in the retailers' truck to the feed room on the farm has become an accepted practice. Data have been obtained from store managers concerning delivery routes and practices. In addition, detailed time and observation records have been made while traveling with truckmen on their delivery routes.

Most stores have regular weekly truck routes and will deliver one bag or more of grain to any location within their normal trade area. On some routes, the truck mileage and labor involved in delivery of small lots to many scattered locations represent high costs. Due to keen competition among grain dealers, each attempting to maintain or expand his total volume of sales, certain farmers demand and receive extra services which place an additional cost on the delivery system. For instance in a few cases grain is delivered to grain rooms on upper floors of poultry houses.

The delivery of grain by the store may be good farm management in most cases because the operator can use his labor more advantageously at the farm. However, since frequent delivery of small lots of grain to isolated places and the special services to some farmers result in large total

delivery costs, the general levels of grain prices to all farmers must be increased. The field work is not complete and the data not analyzed, but there is evidence that more complete cooperation between farmers and grain stores and among grain dealers could result in large savings in labor and mileage of delivery.

Data have been obtained from about 50 poultrymen as to present practices in feeding grain.

While a few operators handle grain in bags fairly efficiently when measured by time, most poultrymen could reduce both time and physical effort by handling it in bulk at the farm.

A preliminary report concerning practices in handling grain in bulk as observed on poultry farms was published and is available as Agricultural Economics Mimeograph No. 11, "Handling Grain in Bulk on New Hampshire Poultry Farms."

H. C. Woodworth

Importance of Apple Refrigeration

Less than a third of the consumers contacted in two New Hampshire cities placed apples in their refrigerators. In a large city (Manchester) the kitchen was the most important storage place. In a small city (Hampton) the cellar was first in importance as a storage place. Few of the stores used refrigerated displays for apples. But refrigeration is not enough; maintenance of high humidity is also important. Storage in a plastic bag in a refrigerator would be ideal for the consumer.

Almost 75 percent of the apples bought were used fresh. Apple sauce was the most important apple product used. Use of frozen apples or juice or apple butter was negligible.

More contacts with consumers, with emphasis on uses of apples, varieties, and other consumer information, appear desirable. Growers are using little advertising directed to consumers..

Convenience of purchase, a more attractive product, and better maintenance of quality would increase apple consumption.

L. A. Dougherty

Increasing Efficiency in the Operation of Milk Distribution Facilities in New Hampshire

Increased competition for milk in the consumers' food budget and increased costs of production and distribution necessitate continuous improvements in existing facilities and methods for milk distribution and assembly. The efficiency of milk distribution refers to the physical movement of milk, the costs of inputs such as labor and equipment, and the pricing methods. To the extent that the State has assumed responsibility for pricing at wholesale and retail, this means of encouraging efficiency is less powerful than it would be under more competitive conditions.

The purpose of this project has been to establish certain measures of efficiency by comparing markets and by the confidential comparison with dealers of their position relative to theirs and other markets. Two measures used were: 1. the ratio of miles traveled to milk delivered, and 2. the ratio of men hours to milk delivered. Increased efficiency obtained in 1945 from every-other-day delivery was reduced by 1950 from uneconomic use of labor and increased distance of delivery to consumers. Some improve-

ment was noted from the increased use of wholesale outlets by dealers which shifted the distribution costs to consumers and retail stores.

Milk in paper containers is delivered by many dealers to chain stores and other retail outlets which eliminates the glass bottle pick-ups and is proving satisfactory.

Benefits to producers can be provided through prices which fairly represent consumer demand for the product and which do not encourage over-expansion with later capital losses. This includes recognition of the declining value of butterfat and the availability of cheaper milk substitutes.

The competitive position of the dairy industry depends greatly on the practices of dealers and handlers. Continuous attempts to reduce costs and eliminate unnecessary services is the only way members of the industry can stay in business. This research aims to keep dealers aware of this problem and to help them formulate plans when possible.

J. R. Bowring

Opportunity for Increased Sales of Fresh Vegetables

The demand for locally grown fresh asparagus is not nearly met in this State. Freshness is an important factor in sales appeal. Sizes of bunches offered varied greatly (1-2 lbs.) and some was offered in bulk. About three fourths of the supply is available from May 15 to June 15 in southern New Hampshire, but many offer asparagus until the first week in July.

Sweet corn sells well but better merchandising methods are needed because sugar loss is rapid, especially at high temperature. Consumers are not getting top quality sweet corn. Less than 20 percent of the retailers knew the varieties they were purchasing. An opportunity exists for greater emphasis on quality with attention to high quality varieties and maintenance of that quality until used by consumers.

A rapid change is being made to sell carrots in plastic bags. The carrots in bags are cleaner, more uniform, small in size, and quality can be maintained by placing the carrots in the refrigerator in the plastic bag in which they are sold.

Tractor digging equipment and modern washing facilities are important to carrot growers who operate on a commercial scale and who expect to maintain their competitive position.

L. A. Dougherty

OTHER ACTIVE PROJECTS

A Study of the Management Problems of Potato Production in New Hampshire

W. K. Burkett

A Study of the Problems of Obtaining Farming Capital

W. K. Burkett

Production Management Problems on Specialized Poultry Farms

H. C. Woodworth

Changes in Population

J. R. Bowring

A Description and Analysis of the Livestock Markets Available to New Hampshire Dairymen and Beef Producers

J. R. Bowring

An Appraisal of and Possible Economics in the Marketing of Poultry in New Hampshire

W. F. Henry

Cost Reduction in Dairying—Reducing Costs of Replacements on New England Dairy Farms

W. F. Henry, G. E. Frick

Agronomy

New Corn and Grain Varieties for New Hampshire Farmers

A few hybrid corn varieties continued to give excellent yields for both silage and grain in the 1951 and 1952 corn trials at Durham. The University's Agronomy Department found the new hybrid, Maine F-150, a good yielder and adaptable to New Hampshire. It should begin to replace Maine "B" and Wisconsin 240 in 1954 since it matures only a day or two later.

Maine F-150 has a taller and stronger stalk than the above dent-flint hybrids. It also produces a more uniform and larger ear. This new hybrid offers promise for use as grain in the higher elevations of the State and in southern Coos County. For silage it could be grown at still higher elevations and in northern Coos County.

Comparative yield data follows:

Yield in Bushels Per Acre	1951	1952
Maine B	54.61	47.64
Wisconsin	56.92	
Maine F-150	59.03	75.03

Another hybrid of the same maturity range as the above is the experimental hybrid, NE9203. It has already given a good preliminary trial yield. This hybrid was released by Massachusetts and should be of interest to New Hampshire farmers since one of its ancestors was an inbred out of the high yielding open-pollinated N. H. 500.

The ever-popular Cornell 29-3 is gradually being replaced by better hybrids such as Massachusetts 63 and Cornell M1 and M4. Cornell 29-3 always lacked uniformity and suffered excessive stalk breakage.

Clinton oats will give way to the new named variety, Clarion. The Clarion, formerly C.I. 5647 in the Northeastern oat uniform trials, is a selection from the Clinton x Marion cross. In 1952, in randomized rows, Clarion outyielded Clinton by ten bushels of grain per acre. Clarion also showed a heavier bushel weight of grain and as good a forage weight. Clarion seed oats should be available to New Hampshire farmers in 1954.

The uniform grain trials in Durham and in other areas of the State would seem to meet the need for which they were set up. Since the New Hampshire growing season is so short, only early maturing varieties are adaptable. It is a guess as to how any new hybrid will respond in a certain

area. Grain variety seeds sold in New Hampshire are now of those varieties that have proved their worth in these controlled unbiased trials.

L. J. Higgins

A Search for Superior Potato Varieties

Because New Hampshire soils and climate differ from other New England States, certain potato varieties may do well here, but not elsewhere. An example of this is the unnamed variety known only as B 355-44. This variety makes excellent potato chips, yields well even during dry weather, and has good baking and frying qualities.

This superior variety is being increased. Certified seed should be available for trial by interested New Hampshire growers within the next year or two.

As a result of tests made under this project in previous years, two varieties, Kennebec and Ontario, are now extensively grown in New Hampshire.

Each year, approximately 10 new selections are placed in the test plots from the National Potato Breeding Program of the U. S. Department of Agriculture.

P. T. Blood

Potato Scab on Tubers Grown in Strongly Acid Soils

During 1952, after growing potatoes for seven years on Worthington loam at Colebrook, the check plot with a pH of 4.7 had 13.5 percent of its tuber yield severely infected with scab (*Actinomyces scabies*). The previous year at the same pH this plot had only 1 :1.7 percent of its tubers severely infected with scab. This is a tyical example of the vexatious nature of the potato-scab problem when potatoes are grown year after year in the same soil.

A soil with such a low pH generally does not create a scab problem. Yet in intensive potato farming, where potatoes are grown year after year on the same land, the pH-scab relation often goes askew. It has been suggested by other workers that several factors may be involved, notably organic matter depletion, and the distortion of Ca:K ratios in the soil. The Colebrook plots offer an excellent opportunity for studying these relations since they involve treatments with different Ca:K ratios in the fertilizers and at different pH levels.

L. T. Kardos

Breeding and Testing of Grasses and Clovers

Strain tests were conducted in 1952 on ladino clover at Durham and on alfalfa and smooth bromegrass at Greenland.

Yield data were obtained on seven ladino strains seeded on the Bunker Field in 1949. Breeder's Ladino (FC23608) has performed best for two years, followed closely by certified Oregon Ladino (FC23596). These two strains have exceeded commercial ladino for each year by about 600-700 pounds of dry matter per acre. In general, the three California strains in the test have been lowest in yield. Certified seed has given better yields than comparable non-certified seed. Forage yields have been closely correlated with percent stand as based on hand separations.

Narragansett alfalfa produced significantly more forage than any of the other five varieties in 1952 as it did in 1951. Atlantic alfalfa has yielded well for both seasons whereas Ranger yielded well in 1951 but not in 1952.

Yields were obtained on 25 polycross progenies and 6 New York synthetic-bromegrass strains. Yields of the synthetics were better than for the polycross progenies, as expected. Three of the synthetics produced from 600 to 1,100 pounds more dry matter per acre than Lincoln, the better of the two check varieties.

Observations were made in 1952 on about 2,000 bromegrass plants with regard to reaction to brown leaf spot, vigor, leafiness, and spread. Self- and open-pollinated seed was collected from desirable plants and grown in the greenhouse in the winter. Progenies were transplanted to the field in the spring. About 300 selected plants were brought into the greenhouse during the winter for production of selfed and crossed seed. About 15 species of bromegrass, chiefly from South America, have been grown in the greenhouse and were transplanted to the field in the spring. These species will be evaluated for leaf spot resistance and other characteristics which might be used in crosses to improve smooth bromegrass.

The bromegrass breeding nursery will be increased to include about 3,500 plants representing 85 strains.

Approximately 800 ladino plants were inoculated with the crown-rot organism during the winter. Plants showing resistance will be transplanted to the field for further observation.

A breeding nursery of approximately 2,400 plants, representing 60 strains of ladino clover, will be established.

G. M. Dunn

New Hampshire Perennial Red Clover

Additional Breeder's seed has been obtained by hand pollination and through pollination by bees in the greenhouse from plants that have never been grown outside the greenhouse. The plants which furnished the seed are now from one to two and three years old. There is indication that the New Hampshire Red Clover will persist longer than two years in the greenhouse as well as in the field.

A small amount of seed was in a small field plot. This seed will be used in the 1953 replicated field trials along with the new Breeder's seed, Kenland, Pennscott, and other new red clover strains. Unfortunately, there is not enough seed to fill requests from other experiment stations for further testing. Already, favorable reports of the New Hampshire Perennial Red Clover's persistance has been received from outside New Hampshire. Another attempt will be made to increase the seed supply so that the New Hampshire Red Clover can be entered in the necessary trials to prove its worth.

L. J. Higgins

Split Application of Potash Better for Ladino Clover

Results obtained in 1952 indicate that greater mid-summer yields of ladino clover can be secured without sacrificing early summer yields if part of the potash fertilizer is applied in the spring and part after the first harvest.

At the Colebrook experimental plots second-cutting hay contained about four times as much ladino clover where the potash was supplied in a split application — 50 pounds K_2O per acre in May plus 50 pounds K_2O after the first cutting — rather than as a single application of 100 pounds of K_2O in the spring.

The reason for this lies in the fact that the ladino clover and companion grasses apparently remove so much of the potash from the soil during the fore part of the growing season that there is an insufficient amount left for good growth of the plants during the later part of the season.

L. T. Kardos

Irrigate to Control Pasture Weeds

Pasture irrigation triples the yield and improves the quality of pasture forage by reducing the percentage of weeds. Research conducted by the Agronomy Department has shown that on three-year-old stands of ladino-brome and ladino-timothy, irrigation not only increased by threefold the total forage but also increased the clover and fewer weeds developed.

Under irrigation the percentage of clover was increased more than 80 percent, weeds were decreased by half, while the grass stand was about the same in the irrigated and non-irrigated plots.

P. T. Blood

Fit Your Legume to the Soil

There are approximately 100 different soil types in New Hampshire. Results during the past few years indicate that retention of moisture by these soils may have a very important effect on the yield and persistence of the various perennial legumes. Alfalfa and red clover did better than ladino on a dry soil and during and after prolonged dry spells on moisture retentive soils. Birdsfoot trefoil has persisted well on dry and on moisture retentive soil but has a poorer power of recovery after the first cutting than the other legumes.

Of the soils included in the experiment, the Paxton showed a poor inherent potassium and boron supplying power as reflected in the appearance of severe potash and boron deficiency symptoms on the alfalfa and potash deficiency symptoms on the ladino. Other soils similar to the Paxton will require closer attention to potash and boron fertilization for maximum persistence and yield of the perennial legumes.

L. T. Kardos

Deeper and Better Root Systems for Alfalfa and Ladino

During drought periods greater utilization of moisture reserves in the complete soil profile depends on the depth and extensiveness of the root systems.

New research has been started to find out to what extent deep tillage with and without deep fertilizer and lime placement can be used to induce deeper and more extensive root systems in soils with compact subsoils. Using a deep tillage chisel the compact subsoil of a Paxton loam was chiselled to depths of 12″ and 18″ and lime and/or fertilizer applied at those depths. Studies are to be made on the effect of these treatments on the growth of alfalfa and ladino root systems.

Results obtained in the greenhouse indicate that loosening the compact subsoil and placing lime and fertilizer in the deeper layers resulted in a greater concentration of fibrous roots of alfalfa and ladino in those layers.

L. T. Kardos

OTHER ACTIVE PROJECTS

Influence of the Level of Available Potash in the Soil on the Longevity or Persistence of Clover in Hay Stands

R. L. Donahue

Proper Width and Slope of Beds for Draining Whately and Biddeford Soils

W. H. Lyford

A Survey of the Soils of New Hampshire

W. H. Lyford

Bacteriology

Studies on Bovine Mastitis

The characteristics of staphylococci causing bovine mastitis were investigated. Cows which were free of all mastitis infection were injected, via the teat canal, with different strains of mastitis staphylococci. It was demonstrated that staphylococci producing alpha and beta toxins caused acute cases of mastitis. A strain which formed only beta toxin did become established when injected into quarters of a test cow, but no clinical evidence of infection developed. It was further demonstrated that the alpha toxin was highly irritating to the mammary tissue when injected into the udder, via the teat canal. Typical cases of acute mastitis developed following the injection of this type of toxin. The beta type of toxin was essentially nontoxic when injected into the udder.

In one of the dairy herds under study, the infection spread to new quarters at the rate of about 20 percent per year. Proper disinfection of the teat cups appears to have appreciably reduced the spread of this infection.

Studies are still in progress in an attempt to find drugs that will cure long-standing, chronic cases of bovine mastitis.

L. W. Slanetz

Studies on a Cellulose-digesting Spore-forming Anaerobic Bacterium Isolated from the Bovine Rumen

Bacteriological studies were carried out on a microorganism isolated from the bovine rumen. The organism was isolated using selective media containing cellulose, and the purity of the culture was determined by subsequent transfers in glucose and cellobiose agar media. The organism was a slightly curved, gram-negative rod which frequently produced oval, refractile spores. Cells were 0.3-0.7 u. in diameter, 3-5.2 u. in length. Spores were 1.0 u. in diameter. The organism was an obligate anaerobe requiring a low oxidation reduction potential for growth. The cultural and biochemical properties of the organism were examined. A growth medium

was developed and certain of the environmental conditions necessary for growth were determined. Studies on the fermentation of cellulose were carried out and the fermentation products elaborated were ethyl alcohol, acetic acid, butyric acid, CO_2 and H_2. Reducing sugars were noted in the culture fluids after fermentation, but it was not possible to establish whether these were glucose, celloboise, or both.

E. Katz

OTHER ACTIVE PROJECTS

Diagnosis and Control of Vibriosis in New Hampshire Dairy Herds

L. W. Slanetz

Botany

New Tomato Varieties Resistant to Late Blight

Tomato late blight is a serious threat to both the commercial tomato grower and home gardener, and at times it may completely destroy the crop. Resistant lines have been developed which are not attacked by the common strains of the late blight. The resistant tomato strains have been backcrossed onto standard varieties in order to increase fruit size and improve the horticultural charactertistics. At present progenies from these crosses are being further tested for late blight resistance, and some of them look very promising.

A. E. Rich

Possibilities of Propagating High Sugar-Producing Types of Sugar Maples

Eight hundred maple cuttings were prepared from the spring growth of high sugar-producing trees in June, 1952. Seventy percent of these were given quick-dip hormone treatments and thirty percent were used as controls. The cuttings were placed in sand in a greenhouse ground bed, and a constant mist was kept over them throughout the summer.

By the middle of October, 30 percent of the cuttings had rooted. Of the five hormones used, three showed a higher percentage of rooting than did the controls. Certain trees gave consistently higher percentages of rooting than did others.

The rooted cuttings were placed in an underground storage pit for the winter, and planted in the spring of 1953 to field plots.

S. Dunn

Seasonal Effects of Witchgrass (Quackgrass) Control with TCA

In 1952 three series of randomized plots each of 100 square feet area were treated with sodium trichloroacetate. One series was treated on May 30, another on July 25, and the last on November 7 and 8. At each time three different concentrations of TCA were used, ½, ¼, and ⅛ pounds of TCA per plot. The appropriate amount of material was applied in one gallon of water solution. The fall treatments were relatively ineffective, the low concentration (⅛ pound) was much more effective in July than in late May. At higher concentrations there were no pronounced differ-

ences between the summer and spring treatments. Since these results are in agreement with those of previous years it seems to be apparent that midsummer is the best time of year to treat witchgrass with TCA with the least expenditure of money for materials.

A. R. Hodgdon

New Organic Fungicides Give Good Control of Apple Scab and Excellent Fruit Finish

Sulfur is gradually being replaced for the control of apple scab by new organic fungicides which give better control and cause less injury to the fruit. Phygon has proven to give excellent control of apple scab without causing any noticeable injury when used in the early part of the season. Captan has also given good scab control and excellent fruit finish. Probably it will find a definite place in the spray schedule, especially in the cover sprays. Crag Fruit Fungicide 341 has given good control of scab and good fruit finish, but it has caused some injury to certain varieties when used in combination with some insecticides. It should be given further trial before it is adopted in a complete spray program.

A. E. Rich

Use of Wood Wastes, Such as Sawdust and Lignin in Compost with Soil and Manure, and Their Effect on Plant Growth

Our work done during 1952 was with two types of wood waste composts. The first of these contained mixtures of birch shavings and other organic materials and the second contained mixtures of fresh sawdust and organic materials. Some work was also done with sawdust and sewage sludge mixtures as a soil amendment.

Vegetable crops were grown in mixtures of the above materials and soil throughout the year. This work was done in the greenhouse and in outdoor growing bins.

Hen manure and silage were found to be the most satisfactory supplements to wood waste in a composted form. Sewage sludge did not appear to be as satisfactory. Mixtures of soil and wood waste composts containing satisfactory organic sources of nitrogen gave higher yields than did good fertile soil to which no organic matter was added.

S. Dunn

New and Unusual Diseases in New Hampshire

Needle blight of red pine was observed in several red pine stands in the State. It appears to be associated with insect injury.

Alternaria blight of muskmelons was serious in 1952.

Verticillium wilt of potato and Dutch elm disease continued to increase in distribution and severity.

Black rot of apples was more serious than usual this year. Apple scab, although not new or unusual, was very severe during the 1952 growing season. Potato and tomato late blight, on the other hand, were relatively scarce.

A. E. Rich

OTHER ACTIVE PROJECTS

The Flora of New Hampshire

A. R. Hodgdon

Crops

(See Agronomy)

Dairy Husbandry

Vitamin D Content of Forage Varies Greatly

A study was started four years ago to determine if milking dairy cows maintained under New Hampshire farm conditions needed supplemental vitamin D. It was soon found that the first problem was to learn more about the vitamin D content of the common forages which the cows ate and the factors affecting it.

The results of the study show that the vitamin D content of forage varies widely and depends on a number of factors. The vitamin D content of first-cutting forage harvested at the generally recommended stage of maturity was usually low when mowed and it could not be increased greatly by ultraviolet irradiation. Second-cutting forage was often higher in vitamin D when mowed and it contained appreciable amounts of vitamin D after irradiation. Relatively high levels of vitamin D were found in forages cut at a mature state and these values were increased markedly after irradiation.

The results of this study indicate that first-cutting forage harvested at the generally recommended stage of maturity cannot be considered as a good source of vitamin D even if it is field cured. Because second-cutting hay generally contains considerable vitamin D after field curing, the practice of ensiling first-cutting forage and making the second cutting into hay appears to be a desirable one. This is true not only from the standpoint of the vitamin D intake of the cow, but also in conserving other nutrients.

H. A. Keener

Effect of Texture on the Digestibility and Utilization of Concentrates by Dairy Cows

Because of the questions raised by a preliminary report of the work on the nutritive value of the so-called "fine" and "coarse" textured feeds, it was deemed advisable to repeat the work on an expanded basis. This year the comparison included a very coarse texture and pellets in addition to the coarse and the fine textures studied in 1951. These four concentrate mixtures represent the principal types found in dairy feeds sold in the New England area. All four mixtures were made from the same original lots of ingredients and consequently were of practically the same chemical composition. Enough of the concentrates were mixed at one time to carry through the whole experiment.

In 16 complete digestion and utilization experiments with 4 mature cows, the fine mixture excelled the coarse, very coarse, and the pellets significantly in digestible protein and in total digestible nutrients. The coarse, the very coarse, and the pelleted feeds were essentially equal in nutritive value.

The results of this experiment substantiate those reported in Bulletin 394 (1952) of the New Hampshire Station. They also support the ob-

servation made in a companion experiment, reported in Dairy Husbandry Research Mimeograph No. 3 (May, 1953), that cows fed a fine mixture made greater gains in body weight on the same amount of feed.

N. F. Colovos, H. A. Keener,
H. A. Davis, K. S. Morrow

Too Much Limestone Lowers Digestibility of Silage

The results of the investigation reported last year showed that the addition of 100 grams of limestone daily to the silage ration of yearling dairy heifers lowered the digestibility of the protein by 6 to 8 percent. This posed the very important question of the possible harm which the inclusion of limestone in the ration in improper proportions may have. To obtain more quantitative information on this problem, 9 complete nutritive balance experiments were conducted this past year using 3 dairy heifers with each animal being on a 0, 50-gram, and 100-gram pulverized limestone daily intake along with grass silage.

The investigation shows that the addition of 100 grams of limestone caused a significant depression in the digestibility of the protein and the energy thus confirming the results of the previous year. There was no significant effect in the case of the 50-gram limestone intake. This indicates that amounts normally contained in commercial grain mixtures should have little effect on the digestibility of protein.

N. F. Colovos, H. A. Keener,
A. E. Teeri, H. A. Davis

Effect of Sulfur Dioxide-Silage on Vitamin Synthesis by Ruminants

Insofar as nicotinic acid, riboflavin, and thiamine are concerned in ruminant nutrition, sulfur dioxide appears to be a highly satisfactory silage preservative. Although sulfur dioxide destroys much of the thiamine in the silage, it counteracts the deficiency by producing conditions in the rumen favorable to the synthesis of this vitamin.

The alkalinity resulting from the feeding of limestone is unfavorable to the intestinal or rumen synthesis of thiamine.

A. E. Teeri, D. Josselyn,
N. F. Colovos, H. A. Keener

Mow-cured Hay Excells Silage and Field-cured Hay in Digestibilty of Protein and Energy

The effect of method of storage on the nutritive value of forages has been studied for 3 consecutive years in 20 complete protein and energy balance experiments with dairy heifers. It was found that mow-cured hay excells both the silage and field cured hay in digestibility. During these three years, however, feeding experiments have shown consistently greater gains by heifers fed grass silage. These experiments indicate that while the nutrients of silage are not as digestible as those of hay, they are utilized to a considerably greater extent.

N. F. Colovos, H. A. Keener,
A. E. Teeri, H. A. Davis

Milk vs. Egg Diluter As an Extender for Bull Semen

Using the split-sample technique for a three-month period, fresh skim milk dilutor was compared with egg dilutor with the semen of ten selected bulls (5 Guernsey, 3 Holstein, and 2 Jersey) from the New Hamsphire-Vermont Breeding Association.

The percent of 60-90 day non-returns on the 1,346 first services (309 Guernsey, 643 Holstein, and 394 Jersey) with the milk dilutor was 64.6. For the egg dilutor the percent of 60-90 day non-returns on the 1,347 first services (315 Guernsey, 603 Holstein, and 429 Jersey) was 66.2. The percentage of non-returns was better for the egg dilutor though the difference is not large. On an individual bull basis, five, or half of the bulls, showed a better percentage of non-returns with the milk dilutor.

Several combinations of non-fat dry milk have been tried as a possible dilutor for bull semen in the laboratory. So far the results do not indicate that a combination has been found that is worth sending out to the technicians for a field trial.

H. C. Moore

Sodium Metabisulfite Appears to Have Possibilities As a Silage Preservative

Preliminary studies were carried out using sodium metabisulfite as a silage preservative. It was used at the rate of eight pounds per ton of legume forage and was mixed with the forage as it went through the blower. This white granular material comes in 100-pound multiwall paper bags and retails for 8 to 9 cents per pound.

Silage treated with this material was compared with similar silage made without preservative. Although both silages were of excellent quality, that preserved with the bisulfite was a little milder in odor, contained more carotene, and was a little less acid. It was accepted very readily by lactating dairy cows. It appears that considerable bisulfite will be tried as a silage preservative in the area this year as a result of this work and that carried out at other stations.

H. A. Keener, N. F. Colovos, H. A. Davis

Minor Element Content of Forage Can Be Reduced by Increasing the Yield

A long-time experiment to determine the effect of heavy fertilization and increased yields on the minor element content of forage is in its fourth year. Results to date indicate that heavy fertilization will reduce the minor element of ladino clover as well as that of timothy and brome grass. Elements decreased most were cobalt and copper while iron and manganese were reduced to a lesser degree.

When these forages were fed to dairy cattle along with a low mineral grain mixture, cobalt deficiency symptoms developed first. After this was eliminated another deficiency syndrome developed. It was characterized in growing animals by a poor growth rate, broken bones, anemia, ataxia of rear legs, and nervous symptoms. In lactating animals, poor production, rapid loss of weight after calving, and anemia were observed in both the animals fed timothy hay and in those fed the ladino-brome mixture. A phosphorus deficiency developed after lactation started in the timothy-fed animals, but this was corrected without relieving the other symptoms.

Results to date show that the timothy-fed animals have a very good record of reproduction performance; that for the ladino-brome-fed animals the record is not nearly as good. The significance of this fact is not known.

The work on this project was carried out in cooperation with K. C. Beeson and E. J. Thacker of U. S. Plant, Soil, and Nutrition Laboratory, Ithaca, New York.

H. A. Keener, F. E. Allen, K. S. Morrow, H. A. Davis, G. P. Percival, C. H. Boynton

OTHER ACTIVE PROJECTS

Influence of Herd Management on Milk Production

K. S. Morrow

Relation of Seminal Fluid Fructose Levels to Factors Affecting Breeding Efficiency

C. H. Boynton

Relationship Between the Diet of Dairy Animals, the Digestibility and Utilization of Protein and Energy, the Synthesis of Some of the B Vitamins, and the Activity of the Flora of the Digestive Tract

N. F. Colovos

Entomology

Control of Apple Insects

In the control of plum curculio and red-banded leafroller on apple, Methoxychlor was inferior to Dieldrin. In codling moth control, Methoxychlor was superior to Dieldrin.

In comparative tests against European red mite on apples, Ovotran, Orthotran, and Genite 883 were superior to Neotran. Aramite emulsion and Genite 883 emulsion failed to give satisfactory control at one pint per 100 gallons, but gave good control when used at 1½ pints per 100 gallons.

J. G. Conklin, R. L. Blickle, W. J. Morse

Control of Lice and Mites on Poultry

The northern feather mite was successfully controlled by treating the birds with 10 percent Aramite dust or with 10 percent Neotran dust. Application was made by means of a bulb-type puff duster. A single treatment with Neotran freed the birds from mites in four days. Aramite-treated birds became free of mites within ten days after application.

The common poultry mite was controlled with dusts and sprays of Aramite and with sprays of Genite 923. The miticides were applied to the normal hiding places of the mites.

Poultry lice were controlled with 0.5 percent DDT dust, using dusting boxes, thus allowing the birds to treat themselves. Litter from the poultry house was placed in bushel vegetable boxes to a depth of approximately 3 inches and a 3 percent DDT dust added to give a final 0.5 percent DDT mixture. All birds in the experimental pen dusted themselves within three

days and were entirely free of lice. Cockerels appeared not to dust themselves and had to be treated by hand. A single dust box appeared to be adequate for a pen of 30 to 50 birds.

J. G. Conklin, R. L. Blickle, W. J. Morse

New Records of Insects in New Hampshire

Studies of the Tricoptera of New Hampshire, begun in 1946, have yielded to date approximately 225 species, some of which are apparently new to science. Collections have been made chiefly through the use of light traps.

Studies on the Tabanidae of New Hampshire, begun in 1952, have raised the number of species known to occur in the State to 76.

The European earwig was found in New Hampshire for the first time in 1952, and appears to be well established in at least two localities in the coastal region.

The box elder bug was found for the first time in the State at Manchester in the spring of 1953.

J. G. Conklin, R. L. Blickle, W. J. Morse

OTHER ACTIVE PROJECTS

Synergists for Insecticides

R. L. Blickle

Control of Apple Maggot and Certain Other Economic Insects

J. G. Conklin, R. L. Blickle

Studies on the Ecology of the European Spruce Sawfly

J. G. Conklin

Farm Management

(See Agricultural Economics)

Fertilizers

(See Agronomy)

Floriculture

(See Horticulture)

Forestry

Tree Thinning with Chemicals

As a result of previous experiments, it has been found that trees can be killed by inserting chemically treated paper tabs under the bark in the cambial region. Several thousand trees have now been killed in order to answer the following questions:

First, is it desirable to completely kill the low value over-topping hardwoods to release other trees of higher worth, or will a thinning out of the crowns, with partial killing only, bring about less abrupt changes with equally good results? Second, is wood deterioration so severe as to render the products of completely killed trees unusable from a quality viewpoint? Third, is bark removal simplified and how soon can it be accomplished after treating?

After one year, where oak forms the overstory, white pine appears to be developing normally with only a partial crown-killing of the oak.

In a 25-year-old white pine plantation where 30 percent of the trees have been killed, the crowns of the remaining trees are showing a good lateral development.

Red pine treated in July was attacked by wood borers during late summer. Birds, particularly woodpeckers, fed actively on the insects. Sample trees were felled the following spring. About a third of the tree was unfit for use but the lower two thirds was sound. The bark was very loose, practically falling away from the wood.

Gray birch, 3 to 6 inches in diameter, was treated in June. By early winter the wood in the tops had deteriorated to such an extent that many of the tops were broken during an early snow storm. It was found necessary to slit the bark of birch from end to end of the cut bolts before bark loosening took effect.

L. C. Swain

OTHER ACTIVE PROJECTS

Soil-Yield Relationships of White Pine in Southern New Hampshire

B. Husch

Marketing Forest Products in New Hampshire

L. C. Swain

Fruits

(See Horticulture)

Horticulture

More Flowers for New Hampshire

The compact, low-growing, late-blooming lilac from Korea described in last year's report has been named Miss Kim. Propagated plants have been distributed to interested nurserymen.

This year the New Hampshire Station assumed a national role in the development of pure-breeding gladiolus through inbreeding procedures. In addition to the gladiolus inbreeding being carried on since 1947 at this station, an education program has interested other breeders throughout the nation in starting similar work.

All seedlings from second generation and backcrosses, involving the wild Korean chrysanthemum and some of the good double-flowered va-

rieties useful in the northern United States, proved fully hardy during the winter of 1952-1953. Several selected seedlings are being distributed for further testing. More back-crossed seedlings are being grown for further selection.

The first New Hampshire winter-hardy rambler rose seedling from our hardy rose-breeding project was distributed to other experiment stations for testing this year. A hybrid of the popular Memorial Rose often used as a ground cover in warmer places, and the very hardy, double, pink, bush rose, Betty Bland, it is expected that this single, pink-flowered seedling rambler will be of value both for itself and as a parent of better hardy roses. Many other seedling roses are being tested and will be introduced if they prove worthy.

Of interest to greenhouse men, a second generation of the attractive pot callas described last year are being grown and interesting new flower and leaf combinations are expected.

E. B. Risley, E. M. Meader

Hay-Mulch Pays

Since 1943, hay-mulched McIntosh apple trees, without additional fertilizer, have out-yielded both sawdust-mulched trees and those growing in sod without additional mulch. Also, the foliage has shown consistently darker green color than trees under other treatments. The annual application of nitrogenous fertilizer on such trees beginning in 1948 has, as yet, failed to change the yield status; but foliage color of trees under sawdust treatment has improved.

L. P. Latimer

Culture of the Durham Red Raspberry

Durham red raspberries were grown under hay-sawdust and bark-mulches, and without mulching. All were fertilized with two levels of ammonium nitrate-sulphate (nitroprills) at the rate of 150 and 300 pounds per acre.

Both spring and fall crops were larger on the cultivated plots than on any of the mulched plots.

Picking of the fall crop started two weeks earlier on the cultivated rows than on the mulched rows due to earlier development of the fruit blossoms.

Increasing the nitrogen fertilizer from 150 to 300 pounds did not increase yields or size of fruit on any of the treatments.

R. Eggert

Storage Experiments on New Apple Varieties

A study of the keeping quality of 35 varieties of apples in cold storage has shown that the new varieties — Idared, Fireside and Webster — stored exceptionally well up to May 1. However, it was also observed that McIntosh and Northern Spy also kept much better than usual, which may have been due to the relatively dry growing season in 1952. The varieties Idared and Fireside appear worthy of trial planting for the late market.

A. F. Yeager

Aluminum Foil Wrappings Look Good in Preventing Sun Scald of Fruit Tree Trunks

Trunks of fruit varieties which are normally very susceptible to winter "sun scald" have shown no injury during the last two years when they have been wrapped with aluminum foil. Unwrapped trunks of some of the same varieties have shown considerable injury even though we have not had severe winters during the past two years.

More observations will be necessary to determine the effectiveness of the alumnium foil in preventing sun scald during severe winters.

R. Eggert

Potash and Phosphorous Fertilizers Do Not Increase the Amount of Red in the Skin Color of Northern Spy Apples

Nitrogen applications to hay-mulched Northern Spy apple trees intensifies the green ground color of the fruit. The potassium- and phosphorus-fertilized trees, plus hay mulch, and the hay-mulched trees without fertilizer supplements are somewhat, but not significantly, better colored than the mulched trees receiving the nitrogen, phosphorus, and potassium supplement. This happens because the paler green ground color of fruit on trees fertilized with potassium and phosphorus results in apparent greater brilliance of red color but does not increase the amount of the red pigment in the skin of the fruit.

L. P. Latimer, R. Eggert

Increasing the Magnesium Content of Grasses Used for Mulching Apple Trees

The magnesium content of orchard grass and timothy can be greatly increased by fertilizing the plants with soluble magnesium-containing compounds. Grasses with high magnesium content are more valuable for mulching, particularly when used to control magnesium deficiency in fruit trees.

L. P. Latimer, R. Eggert,
G. P. Percival, S. Dunn

Lettuce Tipburn in Northern New Hampshire

Shortly after thinning out plants in the lettuce rows in a river-bottom field at Colebrook, 8 plots of 50 plants each were treated with borax at the rate of 20 pounds per acre. At harvest time there was no signficant difference between borax-treated and adjacent untreated plots as far as the incidence of tipburn was concerned. Certain areas in a 30-acre field showed less tipburn than others. This apparently was due to the stage of maturity of the lettuce rather than to nutritional differences. Plants on a steep slope and on level land were slower to reach maturity than those growing on level land above this slope and, coincidentally, were less affected with tipburn at the time of observation.

L. P. Latimer

Phosphorus Absorption by Apple Trees

Much of the phosphorus in fertilizers applied annually to soils in New Hampshire becomes fixed and made unavailable to the plants. Tests were

conducted to get more phosphorus into bearing apple trees by applying phosphorus in a foliar spray.

Radio-active phosphorus was found in all parts of the test apple trees, including the roots, after five foliar applications of di-ammonium phosphate-carrying-radioactive phosphorus.

The phosphate uptake by the trees varied greatly in the soil applications but more was absorbed by mulched trees than by those growing in sod. The uptake of the phosphorus by the apple roots was not increased when it was injected into the soil to a depth of eight inches.

To date no improvement in tree growth, yields, or quality of the fruit has been observed as a result of the foliar sprays or soil applications.

R. Eggert

New High-Vitamin Crackproof Tomato Named Doublerich

From a cross between the common tomato and a wild Peruvian variety that had only small greenish-white sweet unmarketable fruits, a new vitamin-rich, crackproof variety has been produced. It has taken 14 years of breeding and selecting to develop this new variety.

Appropriately named Doublerich this variety has an ascorbic acid (vitamin C) content equal to citrus fruits and twice the vitamin C value for ordinary tomato varieties. In 1952 the indeterminate plants of Doublerich produced large attractive red fruits similar in size and shape to other commercial tomato varieties, but this new variety — unlike many of the older varieties — remained free from fruit cracks. Doublerich will be widely tested in 1953. Seed will be increased this summer and thereafter will be commercially available.

A. F. Yeager

Three New Red Horticultural Bean Varieties Being Tested

Three purified lines of horticultural shell beans having better red seed color than the now popular Flash and Shelleasy varieties have been distributed for testing. One line has stringless pods prettily splashed with red color at maturity. All three lines have good bright red seed and pod color and have been highly productive.

E. M. Meader

Seed of Superior Green-Pod Snap Bean Being Increased

Green-pod snap beans having white seeds have proved superior when processed for baby foods. A highly productive line of a white-seeded green-pod snap bean that also seems adapted to machine harvesting, in which the green pods mature rather uniformly, has been originated. The limited amount of seed of this new variety is being increased for release to the seed trade.

A. F. Yeager, E. M. Meader

A Hardy Yellow Peach

Propagation wood of a new peach, designated W1, is being sent out for budding and trial. This is a descendant of a cross between North Cau-

casus peach and Eclipse. It is an oval, medium-size, freestone, yellow variety which has fruited well when Elberta failed completely because of winter injury.

A. F. Yeager, E. M. Meader

Many Interspecific Rubus Hybrids

Thousands of seedlings are growing at the Horticultural Farm in which the following species have been used as parents and crossed with named varieties of raspberry and blackberry: *Rubus pungens, Rubus morifolius, Rubus chamaemorus, Rubus odoratus, Rubus pubescens, Rubus arcticus, and Rubus canadensis.* These may well result in new commercial varieties of raspberries, blackberries, and other brambles.

A. F. Yeager, E. M. Meader

Late-Ripening Strawberries Distributed to Nurserymen

Two good-quality selections, F-2 and F-13, from a cross between N. H. 179 (Tupper x Fairfax) and Fairpeake variety, have been placed with several plant growers for testing and increase. Both of these selections ripen ten days later than Howard 17.

E. M. Meader

Korean Chestnuts Distributed to Nurserymen

Korean chestnuts have continued to be vigorous and fruitful. One single four-year-old tree matured two quarts of shelled nuts. All nuts have been used to grow more seedlings. Three hundred seedlings have been distributed to interested nurserymen and to a number of persons within the State who will grow them to test their hardiness and blight resistance.

E. M. Meader

OTHER ACTIVE PROJECTS

Variety Tests of Fruits and Vegetables

A. F. Yeager, E. M. Meader,
R. Eggert, L. P. Latimer

Development, Improvement, and Maintenance of Blueberry Fields

W. W. Smith, E. M. Meader,
A. H. Hodgdon, J. G. Conklin

Use of Rootstocks and Interstocks as a Means of Securing Smaller, Hardier, and More Productive Apple Trees

W. W. Smith

Marketing

(See Agricultural Economics)

Pastures

(See Agronomy)

Plant Pathology

(See Botany)

Poultry Husbandry

Breeding for Whiter Dominant-White Crosses

A large number of chickens grown for commercial broiler production today are the offspring of dominant-white males mated with New Hampshire females. The commercial broiler grower objects to the presence of red down found in some of these white crosses at hatching time. Frequently the buyer of live broilers discriminates in price against chickens with red appearing in the surface plumage compared to pure-white broilers.

A study is underway to determine the effect of several color factors individually and in various combinations on the amount of red surface color found in first generation dominant-white crosses. Preliminary results show that the off-spring of two pure White Leghorn males mated with red females differ considerably in the amount and intensity of red evident at hatching and at 12 weeks of age.

The possibility also exists that a color factor or factors may be uncovered by backcrossing which may be important in producing white crosses.

W. M. Collins, F. L. Cherms, Jr.

Growth Rate of Durhams and Durham Crosses

Improved growth rate is one of the objectives in working with both the Durham and White Durham breeds. Some progress has been made this year in improving this character in each of the breeds.

Crosses of Durhams and White Durhams were made for the first time this year and the crosses compared well with the pure breeds at eight weeks of age. Best growth resulted from the cross of a White Durham male with Durham females. Although the differences are not striking, they are probably real since the chickens involved were produced in five separate hatches and reared together.

	MALES Average Weight		FEMALES Average Weight	
	Number	Pounds	Number	Pounds
White Durhams	61	2.05	93	1.80
Durhams	166	2.11	207	1.83
Durham male x White Durham females	38	2.12	32	1.94
White Durham male x Durham females	90	2.23	100	1.98

The silver factor has been introduced into the White Durhams this year to produce a whiter surface color.

W. M. Collins, F. L. Cherms, Jr.

Selection for Better Feed Utilization Efficiency

Twelve males and 24 females of the station strain of New Hampshires were fed individually for a period of approximately 5 weeks so as to measure differences in feed requirements for maintenance. The males were of similar weight; the females were all about the same weight and laying at approximately the same rate of production. Among the males and also among the females the most efficient chicken consumed approximately 82 percent as much feed as the least efficient individual.

The most efficient males were mated with the most efficient females; the least efficient male with the least efficient females. The efficiency of feed utilization for growth is being measured in the progeny. There is no difference in average efficiency of the offspring from the two matings, but one family in each mating appears to show promise.

W. M. Collins, F. L. Cherms, Jr.

Will Improved Broilers Result from Crossing Strains of New Hampshires?

Five pure strains of New Hampshires and certain crosses of these strains have been studied for the past 2 years to compare the broiler qualities of the pure strain and cross strain progeny to 10 weeks of age. Some of the strains used in the second year had not been used in the first year.

Fertility and hatchability of cross-mated birds has not been consistently superior to pure-mated birds. Hybrid vigor has resulted from certain crosses as shown by better growth, but there has been a depression in growth from other crosses. In both years the heaviest chickens were from pure-strain matings. It seems likely that a superior strain-cross for broiler production could be found through systematic crossing and evaluation.

W. M. Collins, F. L. Cherms, Jr.

Methionine Fails to Improve Feed Efficiency

Within the last three years, much interest has developed in the poultry industry in supplementation of starting and broiler feeds with the amino acid methionine. This interest has developed because of a shortage and high price of methionine-rich animal proteins such as fishmeal. Also during this period the chemical industry has produced methionine in quantity and at a price which warrants consideration of its use.

In several experiments during the past year and a half, methionine has been added to typical starting and broiler feed at levels varying from one half to two pounds per ton. In no experiment has the methionine improved growth and feed efficiency sufficiently to pay for the increased cost of the feed.

R. C. Ringrose, L. M. Potter, R. M. Hatch

High Efficiency Feed Gives Better Egg Production

It is generally conceded that the use of a "high efficiency" or "high energy" feed for broilers results in the most profit. Yet when feeds incorporating the same principles are offered to poultrymen for laying birds, there is some reluctance to use them.

During the past two years experimental high efficiency feeds have been compounded and studied. Two of the feeds were tested in each of the two years of work. The best high-efficiency feed improved feed efficiency 20 percent in one year and 7 percent in the second year. Of the total of five high-efficiency feeds used, one was equal to the control in one year and all others gave a better feed efficiency. The average improvement was 12.1 percent.

R. C. Ringrose, L. M. Potter, R. M. Hatch

Immunization of Two-Day-Old Chicks Against Infectious Bronchitis and Newcastle Disease by the Spray Technique

While the use of a field strain of infectious bronchitis virus, in a vaccine in birds over four weeks old, has shown definite advantages in the control of the disease in replacement flocks, the procedure could not be used with reliability in broiler flocks. Further, at times serious complications with other respiratory and protozoan diseases often occur when birds over four weeks old are inoculated with infectious bronchitis virus.

During the past year a concentrated effort has been made in the screening of field strains. One strain has been found which has apparent safety and immunizing properties when used on parental-immune chicks at two days of age by means of a spray technique. In addition, it has been found possible to combine this strain with the Blacksburg strain of Newcastle virus and to immunize the birds against both Newcastle disease and infectious bronchitis.

Laboratory chicks were inoculated at two days of age with the combination vaccine. The chicks were parentally immune to Newcastle and infectious bronchitis. At 12 weeks of age the same birds, according to challenge and serological test, possessed resistance to Newcastle disease and infectious bronchitis.

During the past 7 weeks field trials have been initiated on some 176,000 birds under various conditions with apparent safety. Resistance to both Newcastle disease and infectious bronchitis has been demonstrated at five weeks from such trials.

Therefore, if upon further trials at older ages resistance to Newcastle disease and infectious bronchitis can still be demonstrated, it would appear we may have a procedure of immunization which would be of considerable help to the industry in controlling Newcastle disease and infectious bronchitis.

W. R. Dunlop

Influence of Egg Holding-Room Environment upon the Hatchability of Eggs and the Quality of Chicks Hatched

In order to determine whether the environment of the holding room effects hatchability and chick quality an experiment was conducted in which hatching eggs were held under three conditions: (1) walk-in refrigerator (temperature 50°, humidity 80 percent), (2) egg cellar (average conditions), (3) office (high temperature and low humidity).

Hatchability data were obtained and the chicks were graded by a competent grader. The results are as follows:

TRIAL I

Treatment	Hatchability (Percent)	Grade I (Percent)
Refrigerator	77.3	76.3
Egg Cellar	77.8	77.7
Office	69.6	70.0

It is indicated that hatchability and also chick quality were improved when hatching eggs were held under ideal conditions.

W. C. Skoglund

Frequency of Gathering Eggs and Its Effect on Hatchability

One of the management practices we recommend to hatching-egg producers is that they gather their eggs frequently. It is a logical suggestion in that it will reduce the number of dirty and broken eggs, but it also seems logical that it might improve hatchability, especially during the winter and summer months when nest temperatures are not ideal.

A controlled experiment was conducted at the University in which eggs were collected hourly and one-, two-, three-, and four-times daily during each of the four seasons. The results indicate that frequency of gathering has no effect on hatchability. However, the practice of frequent gathering is still recommended to reduce the number of dirty and broken eggs.

W. C. Skoglund

Wing-web Vaccination of Day-old Chicks for Newcastle Disease

Following the announcement two years ago that chicks might be vaccinated for Newcastle disease with the wing-web, modified, live-virus vaccine under four weeks of age, many poultrymen vaccinated the chicks at day old. In many cases it appeared to have little effect while in other flocks a definite mortality occurred.

As no data apparently existed in the carrying out of such a method, preliminary trials were made on breeders showing immunity according to the H-I test. Some were revaccinated by the wing web while in production to get the booster effect. Eggs after a suitable time interval were then saved for hatching from the revaccinated group and a parallel group which had not been revaccinated. It was found that chicks coming from both groups were immune to challenge with a virulent field strain at one to two days of age.

At the same time parallel groups of these chicks were vaccinated by the wing-web method at one day of age with no apparent harm. However, when they were challenged with a virulent field strain at five weeks no resistance could be demonstrated to the disease.

The procedure was again repeated with the parentally-immune and susceptible chicks. All susceptible chicks died at the end of seven days while the parentally immune survived. However, at five weeks of age no resistance could be demonstrated to Newcastle disease according to serological test or challenge techniques.

It, therefore, appeared if parentally-immune chicks are vaccinated by the wing-web method against Newcastle disease, no harm will be done, but at the age of five weeks it is expected they will all be susceptible. While if susceptible chicks are vaccinated at one day of age by the wing-web method, it appears reasonable to expect a heavy mortality seven days later.

W. R. Dunlop

Effect of Nitrophenide (Megasul) Drug When Fed at Different Levels to Birds Through to Maturity

At housing time each year there are often many stunted birds found which must be culled out as undesirable. Upon autopsy a reasonable number of these birds present typical post-mortem findings of a thickened intestinal wall. The area chiefly involved is that commonly termed the duodenal loop and, to some extent, areas of the free portion of the small intestine. This condition is commonly called enteritis. Some investigators have the opinion it is precipitated by a coccidiosis infestation.

Many of these flocks have been fed on a prophylactic level of a coccidiostatic drug up to 12 weeks. From 12 weeks to maturity they do not have the protection of such drugs. Therefore, on this project an effort has been made to find out if feeding the drugs to birds through to maturity would have a detrimental effect on the general health of the bird. Furthermore, it was necessary to determine if the feeding of drugs at various levels would have any effect on the later resistence of the birds to coccidiosis infections.

The drug which has been used so far has been nitrophenide (Megasul). It has been used at two levels, 0.0125 percent and 0.01875 percent. Duplicate groups of 110 birds each have been used at both levels along with duplicate parallel groups on unmedicated feed. According to clinical examination and autopsy, no evidence could be shown where the drug had toxic effect.

Secondly, during the period of feeding, challenges of *E. tenella* and *E. necatrix* were made on random samples from the pens. Controls were run and while they succumbed or lost weight the medicated, along with the unmedicated, resisted infection by the challenge. Therefore, nitrophenide at 0.0125 level or 0.01875 percent level in the feed continued to maturity does not interfere with build up of immunity to *E. tenella* or *E. necatrix* under controlled conditions. Furthermore, no evidence of toxicity could be demonstrated in these birds when fed at these levels through to maturity.

W. R. Dunlop

Abnormal (Bulging) Eye in New Hampshires

The study of a peculiar bulging-eye condition in one line of the Experiment Station New Hampshires is being continued. Associated with the bulging, in adult birds, is an enlargement of the anterior chamber of the eye, some impairment of vision, frequent shaking of the head, and in some instances a pronounced curling upward of the outside toe.

At hatching, distorted and seemingly enlarged pupils have been noted, and at eight weeks of age definite bulging has been observed. The age at which the abnormality manifests itself varies considerably among individuals.

Although this abnormality apparently is not widespread, a similar eye condition previously has been observed in the flock of a Massachusetts Rhode Island Red breeder. This year a bulging-eyed female has been found in another line of our station flock.

Progress is being made in determining the mode of inheritance of the character.

W. M. Collins, P. A. Wilcox

Restricted Feeding to Delay Pullet Maturity

Restricted feeding of growing pullets is frequently advocated to delay sexual maturity and increase initial egg size. Many poultrymen feel that such a program does not produce the best pullets and actually does not accomplish its intended purpose.

In an experiment with chicks hatched in November both high-efficiency and conventional-type feeds were used. Full feeding was compared with a widely recommended restricted feeding program. In this program mash feeding is limited to four hours per day, with oats fed in the afternoon equivalent to a third of the mash consumed. Feed restriction was practiced only to 20 weeks of age after which time full feeding was followed.

When the results were measured at a production level of 50 percent, there was little difference between the two types of feed. Restriction of feed to 20 weeks of age amounted to 17.5 percent and resulted in an eight-day delay in sexual maturity. Egg size was increased slightly while body weight was less for the restricted birds. At 28 weeks of age the body weights were essentially the same, but the restricted birds had laid fewer eggs. Feed cost per bird was less during the growing period for the restricted birds. Additional data on laying house performance will be obtained.

R. C. Ringrose, R. M. Hatch, L. M. Potter

How Much Protein for Egg Production with Meat-type New Hampshires?

It is the feeling of some poultrymen that meat-type New Hampshire hens require more protein for egg production than do production strains of New Hampshires. This belief is probably based on the fact that the meat strains are considerably larger and heavier birds than are the egg strains.

Two experiments have now been completed in which duplicate pens of meat-type New Hampshire pullets were fed levels of 15 and 18 percent protein. In addition, another set of duplicate pens in each experiment were alternated from 15 to 18 to 15, etc., percent protein every 4 weeks.

No significant differences occurred between the two levels of protein. Likewise the alternating level of protein did not produce any important difference nor did it give results that could be correlated with the changes in protein level. Thus the widely recommended level of 15 percent protein for laying chickens is still satisfactory.

R. C. Ringrose, L. M. Potter, R. M. Hatch

Intensity of Artificial Illumination and Its Effect upon Production by New Hampshires

Many of our laying pens are poorly illuminated, the bulbs being of low wattage and covered with dust. Recent recommendations have included: (1) that a light-meter reading of at least two candle-foot power be obtained on the feeders, (2) that from one- to two-watts per four square feet be provided, and (3) that work at the Dutch Agricultural University using 1,500-watt bulbs for short periods gave promising results. In order to provide some data on this subject, an experiment was set up using 50-, 100-, and 200-watt bulbs.

The results obtained were as follows:

Pen No.	Treatment	Eggs per Bird	Feed per Bird
A	No Lights	179.4	114.6
B	50 watts (1 per 4 sq. ft.)	201.3	118.9
C	100 watts (2 per 4 sq. ft.)	194.8	118.3
D	200 watts (4 per 4 sq. ft.)	208.6	128.0

While the data indicates that the pen with the highest intensity of illumination had the highest production, it is not conclusive since the 50-watt pen had higher production than the 100-watt pen, thus indicating that intensity is not an important factor.

W. C. Skoglund

Shank Pigmentation in Broilers

Shank color is a factor when the price of live commercial broilers is determined at the farm. The degree of yellow color in the skin and shanks of chickens is influenced by certain poultry diseases and can also be modified by small changes in the content of the ration. There are indications that shank pigmentation is influenced by genetic factors, but this has not been conclusively demonstrated.

A study to determine whether there are important breed and strain differences in degree of shank pigmentation was begun during the first trial of the 1953 New Hampshire Broiler Test. Preliminary results indicate that there are significant differences in shank pigmentation between the New Hampshire and White Plymouth Rock breeds, and also between strains within each of these two breeds. The study will include strains of these two breeds which are entered in three trials of the 1953 Broiler Test.

W. M. Collins, S. C. Thayer

Better Methods for the Application of the B_1 Newcastle Virus for the Prevention of Newcastle Disease

The greatest difficulty in immunizing against Newcastle disease with the Blacksburg strain, commonly known as the intranasal strain, has been the route of inoculation. Within the past year it has been found possible to spray the vaccine at two to three days of age without handling the chicks. According to laboratory test, a definite resistance can be stimulated in this manner. In order to prove the practicability of such methods some 156,000

birds have been inoculated experimentally under various conditions. The mortality from all causes, including two instances of a severe complication with chronic respiratory agent, has not exceeded 2.3 percent. According to repeated challenges and serological tests, the birds have resistance to Newcastle disease at four weeks of age. During the field trials we have been able to inoculate 10,000 birds in 45 minutes by the spray method which in itself is a considerable time- and labor-saving device.

W. R. Dunlop

OTHER ACTIVE PROJECTS

A Study of Methods in the Development and Managegment of Pastures for Growing Pullets

R. C. Ringrose, R. M. Hatch, L. M. Potter

Soils

(See Agronomy)

Vegetables

(See Horticulture)

State Services

Inspection of Fertilizers and Feedingstuffs

In accordance with State laws regulating the sale of commercial fertilizers and feedingstuffs, 113 samples of fertilizers and 707 samples of feedingstuffs were analyzed during the year 1952-1953. Sixty-five of the 113 samples of fertilizers equaled or exceeded the guarantees. Deficiencies when found were in general small and it is felt that manufacturers are furnishing the farmer with a product that will do the job expected. The results of these analyses are published in Bulletin 397 of the Agricultural Experiment Station.

The 707 samples of commercial feedingstuffs include the following: 656 samples representing ingredients and mixed feeds offered for sale to the public, 23 samples of canned cat and/or dog foods found on sale, 26 samples were drawn in a study to determine the proper sampling technique for sampling "bulk delivery" feed, and 2 samples of special cases of interest to the feed control supervisor were submitted for analysis. Of the ingredient and mixed feed samples, 16.0 percent were deficient in protein, 9.4 percent were deficient in fat, and 4.1 percent contained an excess of crude fiber. A large number of these deficiencies were small. It is felt that the manufacturers endeavor to comply with their guarantees. The analytical results appear in Bulletin 403 of the Agricultural Experiment Station.

The series of 15 samples of feed supplied by the American Oil Chemists Society and the 6 samples distributed by the Association of Feed Control Officials were analyzed. Approximately 100 laboratories through-

out the country participate in these two programs. This provides a measure of the effectiveness of the techniques and methods as used in each laboratory.

Collaborative work endeavoring to improve the methods of analysis for nitrogen in fertilizers, as a part of the program of the Association of Official Agricultural Chemists, has been continued during the year.

Inquiries received from residents of the State concerning the analyses of silages, feeds, and fertilizers have been answered as received. In many cases such inquiries can be answered without analytical work. In 10 cases analytical work was done and results reported.

H. A. Davis

Soil Testing — 1952-1953

During the last fiscal year, residents of the State have submitted 1,696 soil samples for analysis for available nutrients and pH value. This work entailed 11,872 individual determinations. Eighteen peat and muck samples that were submitted for identification and for possible commercial use were analyzed for moisture and organic-matter content and pH value.

G. P. Percival

Seed Inspection

The regular seed inspection work for the State Department of Agriculture was conducted. During the year 2,077 samples were handled in the laboratory. Of this number, 715 samples were collected by the State inspectors and the results of the tests will be reported in Station Bulletin 404; 1,362 samples were sent in by seed dealers in compliance with the clause in the New Hampshire seed law which requires that all vegetable and agricultural seed must have been tested for germination within nine months of being offered for sale. A few of these samples were sent in by farmers who had grown beans, squash, muskmelon, or rye and wished to sell them for seed.

General referee testing has been conducted on samples sent from a central source to all official seed testing laboratories, while regional referee samples were sent out again this year from our laboratory to the 13 official laboratories in the northeast. Referee samples are sent out as a link between the different laboratories in the country — sometimes to compare the interpretations of the cooperating laboratories, sometimes to obtain a large number of figures from which to arrive at standards for various seeds, and sometimes to gain the benefit of having many laboratories work on a new problem such as the germination of pelleted seed or the handling of treated seed.

Bessie G. Sanborn

Diagnostic Service Performed at the Poultry Laboratory

A total of 5,164 specimens of all kinds were submitted to the Poultry Laboratory for diagnosis. These represented 2,002 cases.

A total of 4,581 chicken specimens, 177 turkeys, and 32 miscellaneous birds were examined. Fifty cases, consisting of 16 specimens from various animals, were also handled by laboratory personnel. There were 314 cases of blood samples submitted for immunity tests.

F. E. Allen, A. C. Corbett, W. R. Dunlop

Pullorum Testing

Testing of poultry for pullorum disease in the State is done by the Poultry Laboratory at the University. During the fiscal year, 1,512,219 birds were tested by means of the tube-agglutination test. In addition, 39,203 retests were made, thus giving a total of 1,551,422 samples tested for the year.

Of 502 flocks tested, one was found to harbor infection. Thus 0.19 percent of the flocks under test were infected.

F. E. Allen, A. C. Corbett, W. R. Dunlop

Infectious Bronchitis Virus

The Poultry Laboratory has continued to grow infectious bronchitis virus on embryonating eggs, and after being tested for purity and potency it is sold to poultrymen of the State for inoculation of their susceptible birds. During the fiscal year, 985 lots of this virus were supplied to New Hampshire poultrymen.

F. E. Allen, A. C. Corbett, W. R. Dunlop

National Poultry Improvement Plan

Participation in the various phases of the NPIP work continued to show a decline from the previous year. However, a study of the figures in the table below shows that the size of the hatching-egg producing flocks is increasing steadily. Since this office is primarily interested in the breed stages of the Plan, it is interesting to note that in 1953, 84 percent of the flocks were participating in the breed stages. This compares with 75 percent in 1952 and only 20 percent in 1944.

Year	Number Participating Flocks	Total Number Birds	Average Size of Flocks	Percent Reactors
1944	858	1,342,095	1,564	.04
1951	615	1,559,424	2,535	.0029
1952	554	1,729,328	3,121	.018
1953	463	1,494,676	3,228	.000066

Record of Performance work also continued to decline from a high of 14 participating flocks in 1947 to a low of 6 in 1953. Here again, those breeders that have continued in the trapnest work are trapping more birds and have more individual mating pens per farm.

E. T. Bardwell

Publications

EXPERIMENT STATION BULLETINS

396 *Results of Seed Tests, 1952.* Bessie G. Sanborn.

397 *Inspection of Commercial Fertilizers.* H. A. Davis and E. E. Eastman.

398 *The Use and Management of Mow Driers and Grass Silage Facilities on a Few Farms.* John C. Holmes.

399 *New Hampshire's Idle Farm Land.* W. K. Burkett.

400 *Opportunities in Producing and Marketing Strawberries in New Hampshire.* L. A. Dougherty.

401 *Growth and Feed Standards for New Hampshires.* Lawrence M. Potter and R. C. Ringrose.

402 *Report of the Director of the New Hampshire Agricultural Experiment Station.* H. C. Grinnell and M. C. Richards.

SCIENTIFIC CONTRIBUTIONS

131 Blickle, R. L. *Pyrethrum Synergists.* Soap and Sanitary Chemicals *28*: 121, 1952.

141 Blickle, R. L. *Notes on the Mosquitoes (Culicinae) of New Hampshire.* Proceedings of the Thirty-ninth Annual Meeting of the New Jersey Mosquito Extermination Association.

147 Morse, Wallace J., and Robert L. Blickle. *A Check List of the Trichoptera (Caddis Flies) of New Hampshire.* Entomological News *64*: 68-102, 1953.

148 Eggert, R., L. T. Kardos, and R. D. Smith. *The Relative Absorption of Phosphorus by Apple Trees and Fruits from Foliar Sprays, and from Soil Applications of Fertilizer, Using Radioactive Phosphorus as a Tracer.* Am. Soc. Hort. Sci. *60*: 75-86, 1952.

150 Dunn, Stuart, L. P. Wolfe, Jr., W. A. MacDonald, and John R. Baker. *Field Plot Studies with Sawdust for Soil Improvement.* Plant and Soil *4*: 164-170, 1952.

151 Wolfe, Leonard P., Jr., and Stuart Dunn. *Sawdust Composts in Soil Improvement.* I. Studies on Aeration, Acid Hydrolysis, Manure, and Waste Materials as Composting Aids. Plant and Soil *4*: 223-234, 1953.

152 MacDonald, William, and Stuart Dunn. *Sawdust Composts in Soil Improvement.* II. Pot Culture Studies with Compost Mixtures of Sawdust and Manure, Steam Treated Composts, and Miscellaneous Mixtures. Plant and Soil *4*: 235-247, 1953.

153 Phillips, Thomas G., and Warren Averill. *Phosphorylase and a Branching Enzyme in Squash.* Plant Physiology *28*: 287-292, 1953.

154 Slanetz, L. W., and Clara H. Bartley. *The Diagnosis of Staphylococcal Mastitis, with Special Reference to the Characteristics of Mastitis Staphylococci.* Jour. Infec. Dis. *92*: 139-151, 1953.

155 Teeri, A. E., D. Josselyn, N. F. Colovos, and H. A. Keener. *Effect of Sulphur Dioxide-Silage on Vitamin Excretion by Ruminants.* Jour Animal Sci. *12*: 15-18, 1953.

RESEARCH MIMEOGRAPHS

Agricultural Economics

10. Bowring, J. R., and John C. Holmes. *Comparing Market Efficiency in the Delivery of Milk.*
11. Woodworth, Harry C. *Handling Grain in Bulk.*

Dairy Husbandry

3. K. S. Gibson, H. A. Keener, K. S. Morrow, and N. F. Colovos. *The Relative Value of Coarse and Fine Concentrates for Dairy Cows.*
4. N. F. Colovos, H. A. Keener, H. A. Davis, K. S. Morrow. *The Effect of Texture on the Digestibility and Utilization of Concentrates by Dairy Cows.*

Changes in Personnel

Adams, Harold, Assistant Editor for Agriculture and Home Economics. (July 5, 1949-April 30, 1953)
Bilbruck, James, Graduate Assistant in Botany. (July 1, 1952-)
Berry, Stanley, Graduate Assistant in Horticulture. (February 1, 1952-June 30, 1953)
Chermes, Frank L., Graduate Assistant in Poultry. (July 1, 1952-)
Davis, Marvin, Laboratory Technician in Poultry. (September 1, 1952-)
Donahue, Roy L., Agronomist. (August 1, 1952-)
Donovan, Emily, Assistant Laboratory Technician in Poultry. (July 1, 1952-)
Eastman, Elizabeth, Assistant Chemist. (July 1, 1951-August 16, 1952)
Eastman, M. Gale, Director Emeritus (Deceased January 2, 1953)
Enos, Henry F., Jr., Graduate Assistant in Agricultural Chemistry. (August 1, 1952-)
Feuer, Reeshon, Assistant Agronomist. (July 1, 1947-February 9, 1953)
Ford, Richard, Senior Laboratory Technician and Research Assistant. (December 1, 1943-May 16, 1953)
Fox, Arthur G., Assistant Agricultural Engineer. (September 1, 1949-September 13, 1952)
Gamble, John F., Graduate Assistant in Agronomy. (September 15, 1951-June 30, 1953)
Gibson, Kenneth, Graduate Assistant in Dairy Husbandry. (September 1, 1951-June 30, 1953)
Hatch, Richard, Graduate Assistant in Poultry Husbandry. (July 1, 1952-)
Holmes, John C., Research Assistant in Agricultural Economics. (Deceased March 26, 1953)
Keefer, Garrett V., Graduate Assistant in Bacteriology. (February 1, 1953-)
Kelsey, Theodore, Graduate Assistant in Agronomy. (July 1, 1952-October 31, 1952)
Kriebel, Howard, Assistant Forester. (July 1, 1951-August 31, 1952)
Leventhal, Robert E., Graduate Assistant in Poultry. (May 1, 1953-)
MacDonald, William, Research Assistant in Botany. (June 1, 1951-December 31, 1952)
Myers, Norman, Assistant Treasurer. (January 30, 1953-)
Pelletier, R. A., Graduate Assistant in Bacteriology. (July 1, 1952-)
Platts, Francis, Research Assistant in Home Economics. (July 1, 1945-June 30, 1953)
Rines, Bernard P., Associate Agricultural Engineer. (July 1, 1949-June 30, 1953)
Staab, Vesta, Assistant in Agricultural Chemistry. (August 18, 1952-)
Strout, Richard, Graduate Assistant in Poultry Husbandry. (August 15, 1952-)
Thomas, Richard, Graduate Assistant in Agronomy. (July 1, 1952-)
Toko, Harvey V., Graduate Assistant in Botany. (February 1, 1953-)
Van Wijk, Marjan, Laboratory Technician in Agricultural Chemistry. (September 15, 1951-August 31, 1952)
Wignot, Maureen, Laboratory Technician in Agricultural Chemistry. (September 1, 1952-January 31, 1953)
Wodarski, Edmund, Graduate Assistant in Bacteriology. (February 1, 1952-December 31, 1952)

New Hampshire Agricultural Experiment Station Staff

June 30, 1953

Administration

Harold C. Grinnell, ph.d., Director
Mathias C. Richards, ph.d., Associate Director
Russell C. Smith, b.a., Purchasing Assistant
Norman Myers, b.a., Assistant Treasurer
L. Franklin Heald, b.a., Editor
Thelma Brackett, a.b., Librarian
Roger J. Poulin, a.b., and b.s.l.s., Library Assistant in Charge, Plant and Animal Sciences Library
Maisie C. Burpee, Secretary
Theresa R. Batchelder, Mail Clerk

Agricultural and Biological Chemistry

Thomas G. Phillips, ph.d., Chemist
Stanley R. Shimer, m.s., Associate Chemist
Arthur E. Teeri, ph.d., Associate Chemist
Gordon P. Percival, m.s., Associate Chemist
Henry A. Davis, m.s., Assistant Chemist
Warren Averill, ph.d., Assistant Chemist
Margaret Loughlin, m.s., Research Assistant
Dorothy Josselyn, Assistant
Vesta Staab, b.s., Assistant

Agricultural Economics

William P. Henry, m.s., Agricultural Economist
Harry C. Woodworth, m.s., Agricultural Economist
Wilfred K. Burkett, ph.d., Associate Agricultural Economist
James R. Bowring, ph.d., Associate Agricultural Economist
Lawrence A. Dougherty, b.s., Assistant Agricultural Economist
George Frick, m.s., B.A.E Cooperator

Agricultural Engineering

Bernard P. Rines, bsae and e.e., Associate Agricultural Engineer

Agronomy

Roy L. Donahue, ph.d., Agronomist
Leroy J. Higgins, b.s., Associate Agronomist
*Ford S. Prince, b.s., Agronomist
Louis T. Kardos, ph.d., Associate Agronomist
Paul T. Blood, m.s., Assistant Agronomist
Gerald M. Dunn, ph.d., Assistant Agronomist
Walter Lyford, m.s., Soil Surveyor
Bessie G. Sanborn, Seed Analyst
John F. Gamble, b.s., Graduate Assistant
Richard E. Thomas, b.s., Graduate Assistant

Bacteriology

Lawrence W. Slanetz, ph.d., Bacteriologist
Edward Katz, ph.d., Assistant Bacteriologist
Fred E. Allen, d.v.m., Veterinarian
Agnes T. Richardson, b.s., Laboratory Assistant
Raymond A. Pelletier, b.s., Graduate Assistant
Joseph Marelli, Departmental Technician
Garrett Keefer, b.s., Graduate Assistant

Botany

Albion R. Hodgdon, ph.d., Plant Taxonomist
Stuart Dunn, ph.d., Plant Physiologist
Charlotte G. Nast, ph.d., Associate Cytologist
Avery Rich, ph.d., Plant Pathologist
John R. Baker, b.s., Graduate Assistant
James D. Bilbruck, b.s., Graduate Assistant
Harvey Toko, Graduate Assistant

Dairy

Kenneth S. Morrow, m.s., Dairy Husbandman
Harry Keener, ph.d., Dairy Husbandman
Herbert C. Moore, m.s., Associate Dairy Husbandman
Nicholas F. Colovos, m.s., Associate Animal Nutritionist
C. H. Boynton, m.s., Associate Dairy Husbandman
A. D. Littlehale, Herdsman
Kenneth S. Gibson, b.s., Graduate Assistant

* On leave of absence.

Entomology

James C. Conklin, ph.d., Entomologist
Robert L. Blickle, ph.d., Associate Entomologist
Wallace J. Morse, b.s., Research Assistant in Entomology

Forestry

Clark L. Stevens, ph.d., Forester
Lewis C. Swain, m.f., Associate Forester
Bertram Husch, ph.d., Associate Forester

Home Economics

Frances Platts, m.ed., Research Assistant

Horticulture

Albert F. Yeager, ph.d., Horticulturist
L. Phelps Latimer, ph.d., Associate Horticulturist
Elwyn M. Meader, m.s., Associate Horticulturist
William W. Smith, ph.d., Associate Horticulturist
Russell Eggert, m.s., Superintendent, Horticultural Farm
Edward D. Risley, b.s., Assistant Horticulturist
Putnam Payne, b.s., Graduate Assistant
S. Z. Berry, b.s., Graduate Assistant
Radcliffe Pike, m.s., Collaborator

Poultry

Winthrop Skoglund, m.s., Poultry Husbandman
Richard Ringrose, ph.d., Poultry Nutritionist
Fred E. Allen, d.v.m., Veterinarian
Alan C. Corbett, d.v.m., Pathologist
William R. Dunlop, d.v.m., Assistant Poultry Pathologist
Walter M. Collins, m.s., Poultry Geneticist
Lawrence M. Potter, b.s., Graduate Assistant
Frank L. Cherms, Jr., b.s., Graduate Assistant
Richard M. Hatch, b.s., Graduate Assistant
Richard Strout, b.s., Graduate Assistant
Robert E. Leventhal, b.s., Graduate Assistant
E. T. Bardwell, b.s., R.O.P. Supervisor
C. F. Zoerb, Poultry Inspector
Donald S. Cross, Senior Laboratory Technician
Marvin Davis, Laboratory Technician
Kathryn Moore, Assistant Laboratory Technician
Emily Donovan, Assistant Laboratory Technician

Expenditures for the Fiscal Year Ending June 30, 1953

	Hatch	Adams	Purnell	Section-5	Bankhead-Jones 9 (b) 1-2	Bankhead-Jones 9 (b) 3	Supplementing
Personal Services	$14,202.11	$13,890.12	$55,793.80	$10,183.75	$25,230.37	$5,797.06	$77,429.45
Travel	1.60	70.78	737.33	58.12	122.62	1,803.85	4,791.59
Transportation of Things	2.47	8.15	30.11		14.37	4.20	82.16
Communication Service	245.43	6.65	24.78	3.23	12.75	23.55	883.80
Rents and Utility Services			75.00				608.00
Printing, etc.			5.50		74.45	24.00	1,620.29
Other Contractual Services			148.79		24.08	358.45	230.32
Supplies and Materials	286.29	606.30	2,681.51	210.14	1,823.88	1,485.49	24,484.20
Equipment	262.00	418.00	503.18	908.19	383.13	3.40	9,888.21
Totals	$15,000.00	$15,000.00	$60,000.00	$11,363.43	$27,685.65	$9,500.00	$120,018.02

Income for Supplementary Expenditures	
State Money Offsetting Federal Funds	$39,049.08
State Money for Station	45,614.79
Research Sales	10,375.16
Other Income (Mostly from Private Grants)	24,978.99
	$120,018.02